

NEW AND LITTLE-KNOWN SPECIES OF *FORCIPOMYIA*
(DIPTERA: CERATOPOGONIDAE) ASSOCIATED WITH
COCOA POLLINATION IN BRAZIL

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Abstract.—Two new species of *Forcipomyia* Meigen that are common in cocoa plantations in Brazil, and are involved in cocoa pollination, are described and figured: *Forcipomyia* (*Forcipomyia*) *soriai* Wirth and *Forcipomyia* (*Lepidohelea*) *winderi* Wirth. A key is given to distinguish the subgenus *Forcipomyia* s. str. from the closely related subgenus *Lepidohelea* Kieffer. Keys are also presented to distinguish the Neotropical species of the *squamitibia* Group of *Forcipomyia* s. str. which includes *F. soriai*, and the Neotropical species of the *bicolor* Group of *Lepidohelea*, which includes *F. winderi*. Information on the immature stages and biology for these and related species is summarized and the immature stages of *F. (F.) pinamarensis* Spinelli, also associated with cocoa, are described and figured.

Key Words: Ceratopogonidae, *Forcipomyia*, cocoa, pollination

Biting midges of the genus *Forcipomyia* Meigen are important pollinators of cocoa (*Theobroma cacao* L.) wherever it is grown throughout the tropics. A voluminous literature has accumulated in the past 30 years dealing with the taxonomy, biology, and relation to cocoa pollination of numerous species of *Forcipomyia*, especially of the subgenus *Euprojoannisia* Brèthes. That which appeared up to 1977 was reviewed by Winder (1978). Approximately three-fourths of the 70 species of Ceratopogonidae that have been collected in cocoa flowers belong to the genus *Forcipomyia*. Nearly a third of the *Forcipomyia* midges belong to the subgenus *Forcipomyia* s. str., while in decreasing order of importance the subgenera *Euprojoannisia* Brèthes, *Thyridomyia* Saunders, *Lepidohelea* Kieffer, *Microhelea* Kieffer, *Warmkea* Saunders, and *Lasiohelea* Kieffer, are also involved. There is considerable

variation in the abundance and importance in pollination between these taxa, between individual species, from region to region, and also with the season.

From 1967 to 1983 intensive studies were carried out by John A. Winder and Saulo de Jesus Soria at the Cacao Research Center (CEPLAC) at Itabuna, Bahia, Brazil. More recently Winder has resumed his cocoa pollination studies at the Fazenda Almirante, near Itajuípe in Bahia, and I have had the opportunity to cooperate in the determination of the ceratopogonids from his collections. In Bahia, and especially at the Fazenda Almirante, by far the most abundant ceratopogonids collected in the cocoa plantations belong to the *Forcipomyia* *bicolor* Group in the subgenus *Lepidohelea*, and the *F. squamitibia* Group in the subgenus *Forcipomyia*. The purpose of this paper is to describe the two most important species in

Winder's collections to make the names available for his biological studies, and to provide means for distinguishing them from closely related species.

Explanation of the taxonomic characters used can be found in the general papers on Ceratopogonidae by Wirth et al. (1977) and Downes and Wirth (1981), and the revision of the North American *Euprojoannisia* by Bystrak and Wirth (1978). Holotypes and allotypes of new species are deposited in the National Museum of Natural History (USNM), Smithsonian Institution, Washington, D.C.; paratypes as available in the Florida State Collection of Arthropods, Gainesville, Florida; California Academy of Sciences, San Francisco, California; Museo de La Plata, La Plata, Argentina; Instituto Oswaldo Cruz, Rio de Janeiro, Brazil; British Museum (Natural History), London; and Museum National d'Histoire Naturelle, Paris.

Taxonomic work on the cocoa-pollinating *Forcipomyia* midges has as its main purpose the identification of the most important pollinating species, the location of their most important breeding places, and the accumulation of enough information on their biology so that a practical regimen of cocoa culture and midge habitat manipulation can be devised to maximize cocoa pollination and crop production (Young 1982, 1983). Although the study of *Forcipomyia* breeding places and identification of immature stages has been pursued intensively in America since the early work of Saunders (1956, 1959), progress has been difficult and slow. Nevertheless, important contributions have been made by Winder and Silva (1972), Winder (1977a), Soria et al. (1979), and Soria and Wirth (1979) in Brazil, and Young (1982, 1983, 1986) in Costa Rica.

Larval habitats of *Forcipomyia* midges are somewhat correlated with their taxonomic group. The habitats of *Euprojoannisia* species are usually semiaquatic situations such as algae-covered rocks or mud, wet moss or leaves, mats of decaying aquatic vegetation, and leaf axils of water-holding plants. Spe-

cies of *Thyridomyia* usually are found in association with moss or algae in rather damp habitats. Immature stages of *Warmkea* species are frequently found in leaf axils of *Pandanus*, aroids, and epiphytic and terrestrial bromeliads, and less often in rotting cocoa leaves on the ground, in banana stems, and in bracts of *Heliconia*. Species of the subgenera *Forcipomyia*, *Lepidohelea*, and *Schizoforcipomyia* are less aquatic and are more commonly associated with rotting plant material, which in cocoa plantations and their environs often involves heaps of cocoa pods, old banana stems, cocoa leaves, coconut debris, bracts of *Heliconia* and *Calathea*, and rotting fruits of coconut, calabash, palm nuts, etc.

The taxonomic key to the subgenera of *Forcipomyia* published by Wirth and Ratanaworabhan is out-dated and has been replaced by that of Debenham (1987a). Until the work of Debenham (1987a, b, c), it was not possible with confidence to distinguish between the subgenera *Forcipomyia* s. str., *Lepidohelea*, and *Schizoforcipomyia*, but she pointed out characters in all stages to make possible a key to these taxa for the Western Hemisphere.

KEY TO SUBGENERA OF *FORCIPOMYIA* RELATED TO *LEPIDOHELEA*

1. Hind tarsal ratio about 1.0; wing usually with pale costal spot or pale mottling; second radial cell short, costal ratio about 0.5 2
- Hind tarsal ratio less than 0.5 or greater than 1.5; wing usually without pale markings; costal ratio and second radial cell various miscellaneous subgenera of *Forcipomyia*
2. Body wings, and/or legs with flattened striated scales ranging from long and 1-striated setae to broad, short, multistriated scales; palpus with third segment more or less spindle-shaped, slightly more swollen on basal half with sensory pit located at about $\frac{1}{3}$ length; legs with characteristic banding of alternating pale and dark bands, at least on hind tibia; male genitalia often with whitish dististyle and bicolored ninth sternum and basistyle; dististyle without long setae on outer margin; aedeagus various; larva with *b* hairs of body, and *p* and *q* head hairs swollen near base and becoming filamentous

- distally, usually some about as long as body of larva; anal pseudopod of larva cleft with each branch bearing 6–8 hooklets apically and 3–4 hooklets on inner lateral side
- Body, wings, and legs rarely with flattened striated scales; palpus with third segment swollen on basal $\frac{1}{3}$ – $\frac{1}{2}$, slender distally, with sensory pit located at basal $\frac{1}{4}$; legs, if banded, not with alternating pale and dark bands on hind tibia; male dististyle not contrasting whitish, but with well-developed setae on outer margin; aedeagus shield-shaped, apex pointed with median ridge; larval *b* hairs and *p* and *q* head hairs not as above; anal pseudopod of larva not cleft, bearing unbroken row of strong hooks Subgenus *Forcipomyia*
 - 3. Male parameres with basal apodemes forming a U-shaped arch, parameres a pair of slender to stout, straight or bowed, well-sclerotized blades or rods reaching to no more than middle of basistyles; aedeagus various, with low to high basal arch, distal process various, often with recurved points; dististyle straight or slightly curved, tapering to slender tips; palpus 5-segmented; two spermathecae; scales of body and legs never short and broad Subgenus *Schizoforcipomyia*
 - Male parameres separate or indistinctly joined in an anteromesal bridge; parameres various, usually straight slender rods nearly as long as basistyle and tapering to filamentous tip; aedeagus usually much longer than broad, basal arch low or absent, usually stout distally; dististyle often sinuate with expanded tip; palpus 4- or 5-segmented; one or two spermathecae; scales of body and legs often short and broad Subgenus *Lepidohelea*
- nient setose tubercles; respiratory horn large and globular with spiracular openings in a straight row *squamitibia* Group
- Female tibiae without hastate spines; pale wing spot smaller, not covering end of second radial cell; hind tarsal ratio 0.50–0.76; male parameres with bases joined in a broad plate; pupa with setose tubercles that are often elongate and prominent; respiratory horn small to moderate in size, with longer neck and spiracular openings in a more or less irregular row *argenteola* Group

Forcipomyia (*Forcipomyia*)
pinamarensis Spinelli

Figs. 1–11

Forcipomyia (*Forcipomyia*) *pinamarensis* Spinelli, 1983: 121 (male, female; Argentina; figures).

Types.—Holotype female, allotype male, 12 female, 29 male paratypes: Argentina, Buenos Aires Prov., Pinamar, Partido de General Madariaga, 27.iii.1981, G. R. Spinelli (in Museo de La Plata).

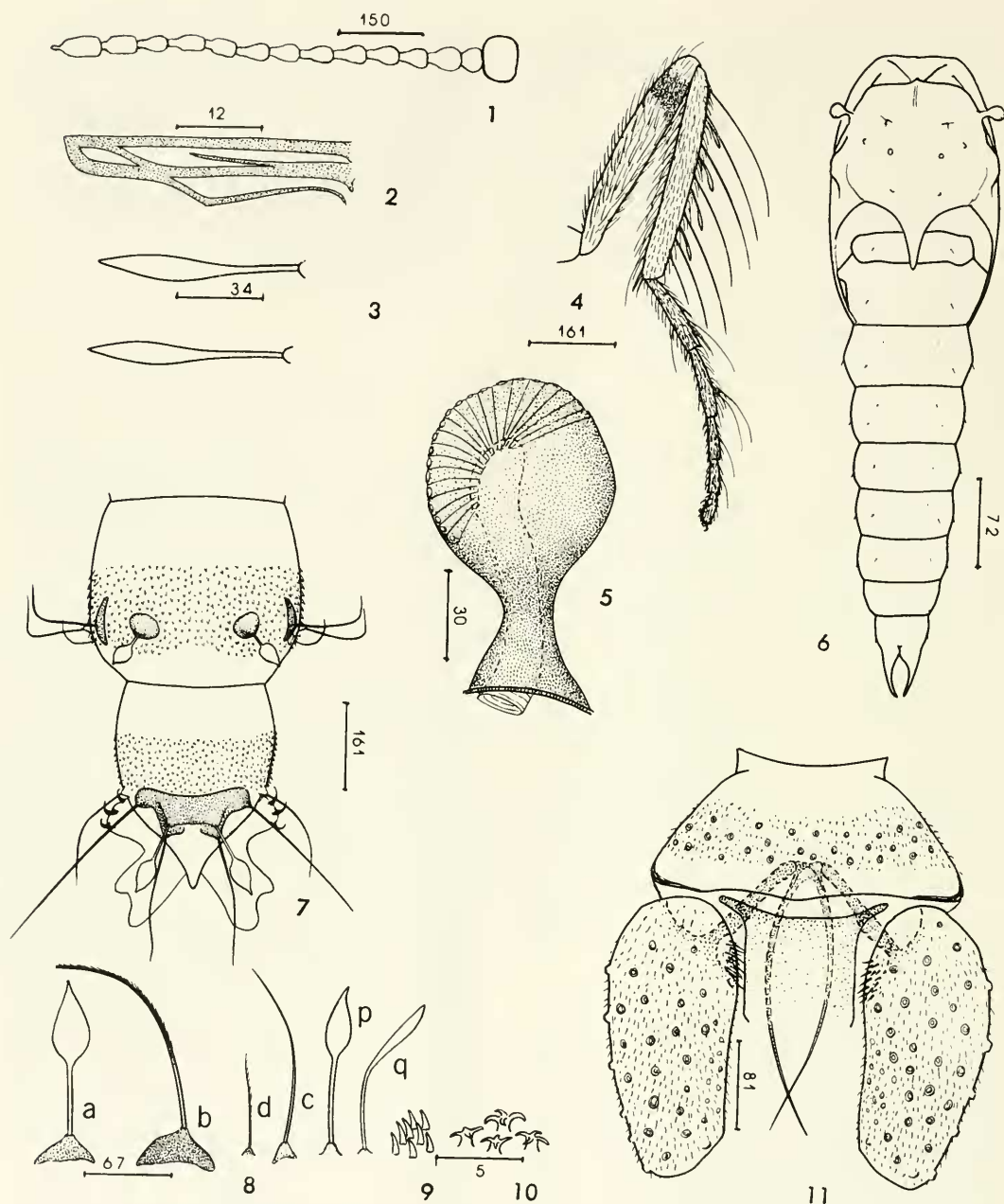
Note.—Shortly before his death in 1968, Professor L. G. Saunders of the University of Saskatchewan very generously donated to the Smithsonian Institution in Washington his extensive worldwide collection of *Forcipomyia* midges, mostly reared from the immature stages, along with his manuscript notes and drawings. Among his manuscript notes were drawings and the description of a species that he collected and reared in Brazil in 1923 and designated as “B-70.” During the present study it was determined that Saunders’ “B-70” was the same species that Spinelli described as *Forcipomyia pinamarensis* from Argentina. This species is abundant and widespread in cocoa plantations; therefore this opportunity is taken to publish Saunders’ description and figures of the adults and immature stages, and to list new distribution records. The following descriptions are adapted from Saunders’ manuscript notes:

“Larvae of this species were taken in fair numbers under the bark of a rotting log in the forests of Corcavado, Rio, 18.viii.1923.

Subgenus *Forcipomyia*, s. str.

Wirth (1982) discussed the taxonomy and biology of the Neotropical *Forcipomyia* s. str. associated with cocoa pollination, including four species which he placed in the “*argenteola* Group.” He also diagnosed and keyed out *F. (F.) squamitibia* Lutz, which with similar species could be confused with species of the *argenteola* Group. Species of these two groups can be separated by the following key:

1. Female tibiae with row of hastate spines on extensor surface; pale wing spot at end of costa larger, including most of second radial cell; hind tarsal ratio about 1.0; male parameres with slender common base; pupa without promi-



Figs. 1-11. *Forcipomyia pinamarensis*: 1-4, female; 5, 6, pupa; 7-10, larva; 11, male: 1, antenna; 2, radial veins of wing; 3, hastate spines of tibia; 4, hind leg; 5, respiratory horn; 6, pupa; 7, last two abdominal segments; 8, head and body setae, lettering as in text; 9, 10, integumental armature of body; 11, genitalia, partial (drawn by L. G. Saunders; scale in microns).

Pupae and adults were obtained from them in due time.:

"Larva. Color white, the macrochaetae black, their papillae light brown. Head ochreous to black around mouth. Prothoracic pseudopod of moderate length, forked in its distal half, with the crown of hooks disposed equally over the end of each branch. Chaetotaxy (Fig. 8): *p* and *q* hairs of head lanceolate; *a* hairs of body lanceolate; *b* and *d* separate, *b* short, curved, spinulate distally. Dorsal hairs of last abdominal segment arising from a cap of chitin (Fig. 7). Cuticular armature in form of short stout stem with a number of apical arms (Fig. 10); simple cones or hooks on pleura and last abdominal segment (Fig. 9). Cauda pointed. Anal blood gills bilobed, the outer lobe much smaller than the inner.

"Pupa (Fig. 6). Color (exuviae) pale ochreous throughout. Head devoid of papillae. Thorax with one dorsal pair of setigerous papillae and three other pairs of very small papillae. Abdomen with no cuticular spines, few microchaetae. Terminal abdominal processes of moderate length. Prothoracic respiratory horn (Fig. 5) in form of subspherical knob on short, broad-based stem. About 16 spiracular papillae having small external membranes curve up the posterior side and over the top. Length 2.3 mm.

"Adult Female. Face pale, ocellar triangle faintly brown; dark ring around bases of antennae. Palpus brown with light bands at distal articulations; segment three much swollen in proximal one-third, distal neck tapering gradually; proportional length of segments, 9:11:37:21:13. Antenna (Fig. 1): Scape light brown, flagellum white tinged faintly with brown distally; proximal segments flask-shaped with broad elongated neck; proportion of first 8 to last 5 segments, 43:34; last 5, 6:6:6:6:10; terminal style a large knob with indented extremity. Thorax uniformly brown on dorsum, with coarse golden pubescence; humeral angles pale; scutellum brown to dark brown around margins; postscutellum dark brown. Pleura

light brown on all the usual sclerites; a very small sclerite in front of the base of the wing dark brown. Legs ochreous, fore and middle coxae brown, hind coxa paler; a fuscous band just before extremity of hind femur (Fig. 4); duskiness of tibiae due to presence of narrow black squamous hairs; outer surface of all tibiae with a few ochreous lanceolate to squamous hairs (Fig. 3), not striated like the more usual decumbent hairs of legs and abdomen. Proportional length of hind tarsal segments, 15:12:7:6:5. Wing densely clothed with dark hairs, narrowly squamous; area of pale yellowish hairs at end of costa. Branches of radius dividing to form distinct cell (Fig. 2); end of costa at middle of wing, fork of Cu directly below. Halteres white. Abdominal tergites uniformly brown except 8 + 9 which are pale ochreous with faint lateral brown spots; sternites 3-7 pale brown with stronger lateral coloring, 8 yellowish. Cerci pale. Tergites and pleural membrane clothed with narrow black-striated hairs; pale simple hairs on venter. Spermathecae two; 0.090 by 0.056 mm, subspherical, no chitinization on neck. Length 1.6 mm; wing 2.11 by 0.45 mm; antenna 0.6 mm.

"Male. Specimen very imperfect. Palps much as in female, but terminal segment longer; proportional lengths, 9:11:38:20:16. Hypopygium (Fig. 11): Aedeagus long, rounded distally, hairy, without lateral carinae. Parameres joined in middle, a slender pair of bowed stylets extends backwards beyond end of aedeagus. Side pieces of forceps long, tapered slightly, with distinct brush of fine hairs on inner side near anterior end; claspers lost.

"This is a very typical *Forcipomyia* conforming closely to type. The larvae are very close to *F. bipunctata* (Linnaeus), differing only in the presence of a chitinous cap on the last abdominal segment and in the extraordinary dorsal cuticular armature. The very bare, spineless pupa is distinctive, possessing as it does a row of unusually small respiratory papillae on the prothoracic horn. The adult female belongs to the small group

exhibiting a row of lanceolate scales on the tibiae; apart from this character they may readily be distinguished from most other species by the minute dark sclerite in front of the wing base."

Distribution.—Argentina, Brazil, Costa Rica, Panama.

Specimens examined.—ARGENTINA: Pinamar, Bs. As., 27.iii.1981, G. Spinelli, 1 female (paratype). BRAZIL: Bahia, Itabuna, 1970, J. Winder, emergence traps, 5 males, 6 females; Bahia, Ilheus, CEPEC, 15.vi.1974, S. Soria, 1 female; Para, km 3, Rodovia Castanhal-Curuca, Faz. Agricultura Bandeirante, 31.v.1980, S. Soria, ex cacao cherelles, 4 males, 2 females; Rio de Janeiro, Corcavado, 18.viii.1923, L. G. Saunders, under bark, 4 larvae, 1 pupal exuviae, 2 females. COSTA RICA: Heredia Prov., vic. La Virgen, Finca La Tigra, 30.vi–3.vii.1980, 25.vii.1981, 11,30.vii.1982, A. M. Young, 2 males, 3 females. PANAMA: Canal Zone, Pipeline Road, vii.1967, F. S. Blanton, light trap, 1 female; Canal Zone, Balboa, fogging *Cassia* tree, 19.vii.1979, E. Broadhead, 1 female; Canal Zone, Gatun, humid forest, fogging *Spondias* and *Cordia* tree canopy, 9–10.vii.1979, E. Broadhead, 2 males, 3 females.

***Forcipomyia (Forcipomyia) soriai* Wirth,**
NEW SPECIES
Figs. 12–21

A hairy yellowish species with dark halteres; female with abundant long, dark, one-striated scalelike setae on radial field of wing and on abdomen; wing with one small yellowish costal spot; tibiae with row of blunt-pointed, pale, hastate setae; hind tarsal ratio 0.92.

Allotype female.—Wing length 1.14 mm; breadth 0.52 mm; costal ratio 0.47.

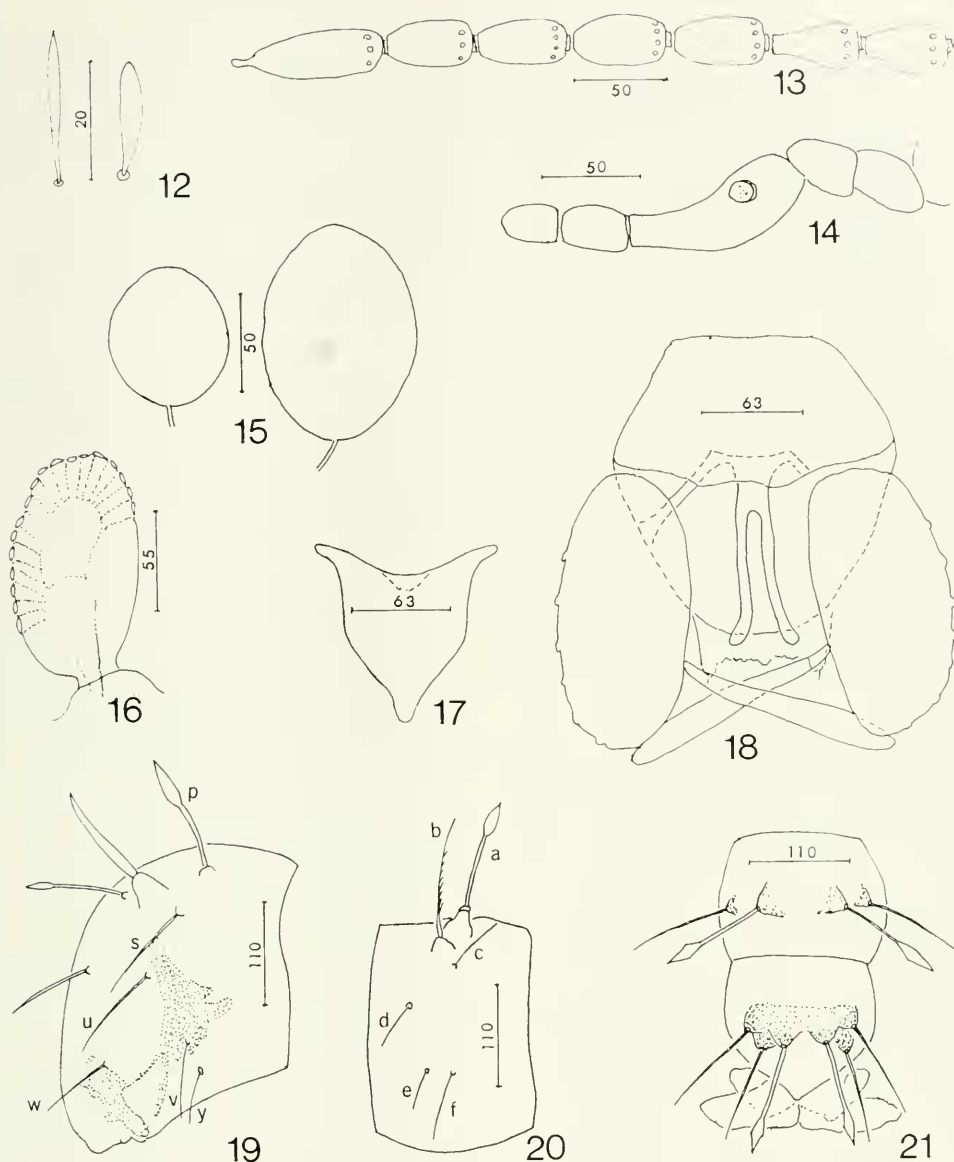
Head: Pale brownish; overall clothed with numerous long, brown, one-striated setae giving a bushy appearance. Antenna (Fig. 13) with lengths of flagellar segments in proportion of 20-15-15-15-15-15-16-15-15-16-16-22, antennal ratio (11-15/3-10) 0.67;

distal segments unusually short for the genus; proximal verticils appearing bushy. Palpus (Fig. 14) with lengths of segments in proportion of 10-11-22-13-10; third segment slightly swollen at base (palpal L/W ratio 2.2), gradually tapering to tip, a small, round, shallow, sensory pit near base; segments 4 and 5 with faint separation. Mandible without teeth.

Thorax: Pale yellowish brown, darker on pleura, scutellum, postscutellum, and coxae. Mesonotum with suberect fine yellowish hairs. Legs uniformly yellowish except tibiae distally and all tarsi proximally, slightly infuscated; with yellowish and brownish, fine hairs, no broad flat scales; tibiae, and tarsi to a lesser degree, with long, slender, brown setae on extensor side; tarsomeres 1–3 with row of strong, blackish, ventral spines, a pair at apices of tarsomeres much stronger; all tibiae with a row of erect, nearly hyaline, hastate setae (Fig. 12) with petiolate bases and bluntly pointed or rounded tips. Claws moderately long and slender, strongly curved, tapering to sharp tips; empodium small. Hind leg with lengths from femur to tarsomere 5 as 82-80-24-26-16-12-8; tarsal ratio (T1/T2) 0.92; hind tibial spur yellowish, straight, slender, tapering to sharp point. Wing densely and uniformly covered with brownish macrotrichia, except two anterior patches of blackish, one-striated, scalelike macrotrichia over radial field and just past end of costa, the two patches separated by a small pale spot of yellowish scales at end of costa. Halter brownish.

Abdomen: Brownish, darker posteriorly with numerous long, brown setae, especially on pleura and on posterior segments. Spermathecae (Fig. 15) two, dark brown, relatively large; unequal, measuring 0.118 by 0.087 mm and 0.087 by 0.075 mm; the larger oval, the smaller subspherical; both with lightly sclerotized, slender, almost thread-like entrances to the ducts.

Holotype male.—Wing length 1.21 mm; breadth 0.43 mm; costal ratio 0.44. Similar to the female with the usual sexual differ-



Figs. 12-21. *Forcipomyia soriai*: 12-15, female; 16, pupa; 17, 18, male; 19-21, larva: 12, hastate spines of tibia; 13, antenna; 14, palpus; 15, spermathecae; 16, respiratory horn; 17, aedeagus; 18, genitalia, aedeagus omitted; 19, head; 20, body segment, lateral view; 21, last two abdominal segments, dorsal view (lettering as in text; scale in microns).

ences. Antenna with well-developed plume of yellowish-brown verticils; lengths of flagellar segments in proportion of 25-15-15-15-15-15-15-16-55-28-20-32, antennal ratio (12-15/3-11) 1.03. Palpus with lengths of segments in proportion of 9-11-27-12-10; third segment more slender at base than

in female, palpal ratio 3.4. Legs with extensor setae longer than in female, hastate spines absent on tibiae; tarsi with numerous long, slender, black spines ventrally; claws long, slender and curved; empodium slender with short rays. Hind leg with lengths from femur to tarsomere 5 as 86-80-24-26-17-13-10;

tarsal ratio 0.92; tibial spur pale yellow, straight, slender, $\frac{1}{3}$ as long as basitarsus, tapering to sharp point. Wing with pale yellowish macrotrichia overall, a small clump of strong blackish macrotrichia over first radial cell and another just past end of costa, the two separated by a small area of yellowish macrotrichia. Halter brownish. Abdomen yellow, with brownish pigmented areas laterally on each segment; with abundant, long, brownish, bristlelike setae, without broad striated scales.

Genitalia (Fig. 18).—Ninth sternum about twice as broad as long, caudal margin slightly convex with shallow mesal concavity; basistyle about twice as long as broad, without stout setae on mesal face but with numerous long, bristlelike setae laterally and distally that are about twice as long as dististyle, the latter straight, slender, and tapered to slender tip. Aedeagus (Fig. 17) shield-shaped, broad basally, length equal to basal breadth, with short basal arms, the basal arch only a slight concavity; sides convex, tapering to a blunt caudomedian point. Parameres with slender, straight, basal apodemes; joined mesally on basal fourth; distal portions relatively stout, nearly straight and parallel, with the blunt tips slightly curved laterad.

Larva.—Length 4–5 mm when mature. Color yellowish white; head capsule pale brownish; dorsal body hairs borne on brownish conical prominences (Figs. 20, 21). Hairs *p* and *q* of head (Fig. 19) long and slender, with spear-shaped tip, that of *p* hair much larger than *q*. Antenna long and tapering, borne on a large subconical pedestal. Body hairs as in Fig. 20; *a* hairs with long slender stem and spear-shaped tip, even on last segment (Fig. 21). Cuticular armature absent. Prothoracic pseudopod cleft, each lobe with 6–7 small brown hooks; posterior pseudopod with a row of 14–16 brown hooks. Cauda short but pointed.

Pupa.—Exuviae only, length not measured. Color pale yellowish, integument without spinules or shagreening. Respira-

tory horn (Fig. 16) irregularly oval in outline, with very short, stout peduncle; in cross-section appearing slightly flattened with the spiracular openings forming a slight rim; 16–18 spiracular openings in a straight row up posterior side and around tip. Body tubercles not developed, setae scarcely visible under high magnification.

Distribution.—Brazil, Puerto Rico, Trinidad.

Types.—Holotype male, allotype female, Brazil, Itajuípe, Fazenda Almirante, 9.v.1988, J. A. Winder, in emergence trap (deposited in USNM). Paratypes, 37 males, 44 females, 1 larva, 2 pupal exuviae: Brazil, same data as types, but dates iv.1987–vii.1989, 28 males, 35 females; Bahia, Itabuna, 1970, J. A. Winder, emergence trap, 6 males, 4 females; Bahia, Ilheus, CEPEC, 4–9.viii.1972, S. Soria, at flowers of cacao, 1 male, 3 females. Puerto Rico, Maricao, 21.i.1953, L. G. Saunders, reared from banana leaves, 1 larva, 1 pupal exuviae, 1 male. Trinidad, no locality, 7.v.1953, L. G. Saunders, reared from wet leaves in stream, 1 larva, 1 pupal exuviae, 1 male.

Discussion.—This species is dedicated to Saulo de Jesus Soria of Bento Gonçalves, R.S., Brazil, in recognition of his long and continued interest and his many important contributions pertaining to the role of ceratopogonids in cocoa pollination throughout Central and South America.

Lane's description and figure of the male genitalia of *F. argenteola* Macfie from Brazil probably refers to *F. squamitibia* Lutz, as all species of this group have the hind tarsal ratio of about 1.0 and the parameres with narrow basal separation and quite slender proximally. *Forcipomyia argenteola*, to the contrary, belongs to a group of species reviewed by Wirth (1982) which has the hind tarsal ratio about 0.5 and the male parameres with bases fused in a broad plate with posterior concavity and the caudal processes relatively stout and tapering to a sharp-pointed tip. Wirth (1982) described the male of *F. argenteola* from males with associated

females from Nova Teutonia, Brazil, the type locality. Species of the *Forcipomyia squamitibia* Group can be distinguished by the following key:

KEY TO SPECIES OF THE
FORCIPOMYIA SQUAMITIBIA GROUP

- 1. Hastate spines of female tibiae in two dense irregular rows; large dark brown species, wing length 1.7–2.0 mm; hind tarsal ratio 1.0 *chilensis* (Philippi)
- Hastate spines of female tibiae in one sparse row; large or small, pale or dark species 2
- 2. Mesonotum with dark vittae; small dark brown species, wing length 0.93 mm; hastate tibial spines brown, short, and broad with sharp tip; hind tarsal ratio 0.9 *sexvittata* Wirth
- Mesonotum not vittate; color, size and tibial spines various 3
- 3. Hastate tibial spines longer than width of tibia 4
- Hastate tibial spines as long as width of tibia or shorter 5
- 4. Yellowish brown species with unmarked yellowish legs; tibial spines slightly longer than width of tibia, swollen in midportion, tapering to sharp tip; antenna pale; third palpal segment swollen on proximal ½; wing length 1.3 mm; hind tarsal ratio 1.0; male parameres with filiform tips straight and parallel *squamitibia* Lutz
- Dark brown species with brown legs; tibial spines much longer than width of tibia, slender and only slightly swollen in midportion; antenna dark brown; third palpal segment swollen on proximal ¾; wing length 1.5 mm; hind tarsal ratio 1.3; male unknown *tenuisquamipes* Wirth
- 5. Legs pale yellow, hind femur with narrow apex brownish; hastate tibial spines petiolate with broad apices; wing length 1.1 mm; hind tarsal ratio 0.9; spermathecae pale; male parameres with filiform tips crossing (Fig. 11) *pinamarensis* Spinelli
- Legs dusky yellowish with tibiae brownish distally, hind femur without distal dark band; hastate tibial spines slightly petiolate with tips moderately broad and slightly tapered to point; wing length 1.14 mm; hind tarsal ratio 0.92; spermathecae dark brown; male parameres stout distally with tips abruptly bent a short way, divergent (Fig. 18) *sorai* Wirth, new species

Subgenus *Lepidohelea* Kieffer

Debenham (1987b) has presented an admirable discussion of the difficult taxonomy

of the subgenus *Lepidohelea*, including characters that may be used to separate the species groups occurring in the Australasian Region. The American species appear to fall in two groups differing from the Old World species, most of which would fall within what Debenham has named the *chrysolopha* Group. The American species may be distinguished from the *chrysolopha* Group by the following key:

- 1. Palpus with four segments; one spermatheca; male dististyle more or less expanded distally (Western Hemisphere species) *annulatipes* Group
- Palpus with five segments; two spermathecae; male dististyle various 2
- 2. Male dististyle straight or slightly curved, tapering to slender tip (Western Hemisphere species) *bicolor* Group
- Male dististyle straight to sinuate, tip more or less expanded (Eastern Hemisphere species) *chrysolopha* Group

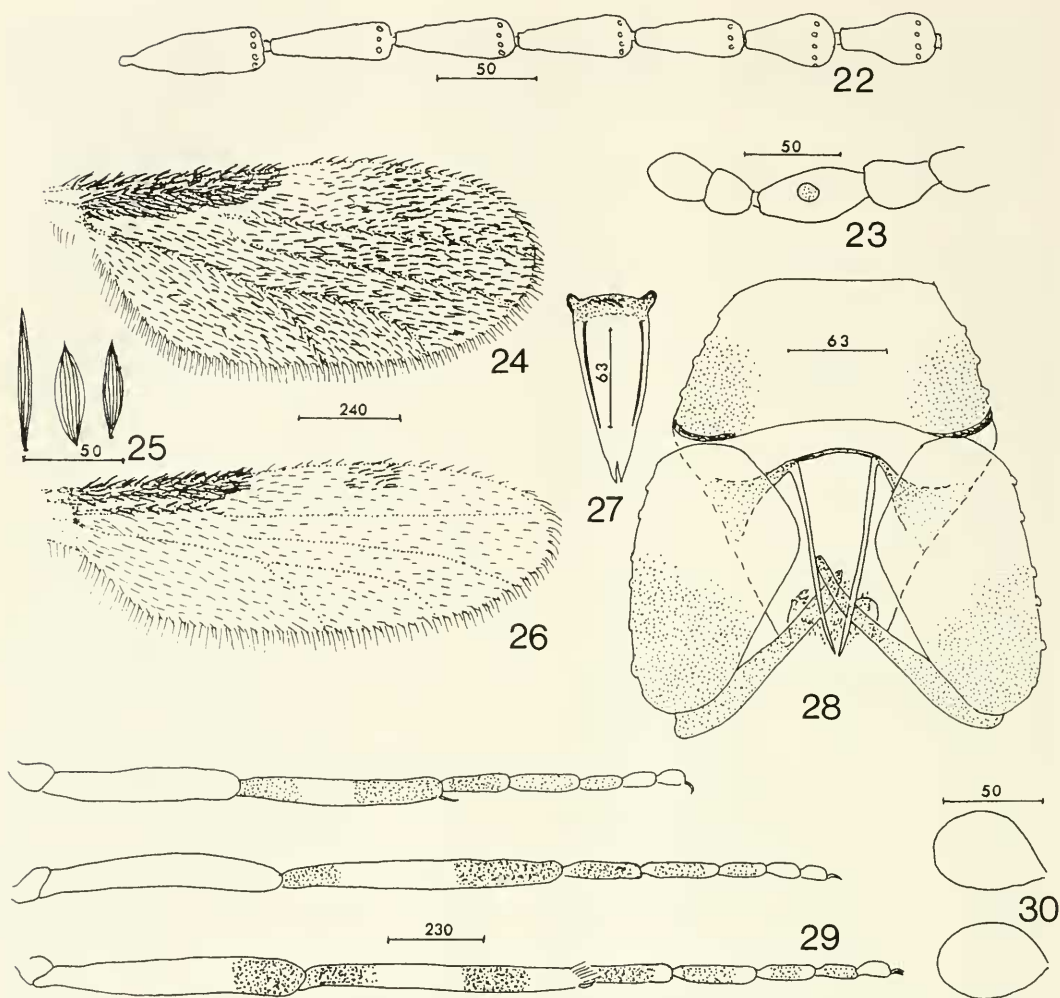
Forcipomyia (Lepidohelea) bicolor
Species Group

Forcipomyia (Lepidohelea) winderi Wirth,
NEW SPECIES
Figs. 22–30

A hairy, predominantly yellowish species with brownish markings; female wing dark with one large pale anterior spot, male wing pale except for dark costal field; palpus stubby, third segment not swollen, with small shallow pit; antenna moderately long; legs banded with *bicolor* Group type markings, femora pale except hind femur with apical dark brown band, all tibiae and tarsi banded; male genitalia with brownish markings laterally on ninth sternum, distal halves of basistyles, and all of dististyles.

Female holotype.—Wing length 1.11 mm, breadth 0.44 mm; costal ratio 0.47.

Head: Pale brownish, overall clothed with numerous long, brown, one-striated setae giving head a bushy appearance, especially strong and numerous on clypeus. Antenna (Fig. 22) with lengths of flagellar segments in proportion of 20-16-16-16-16-16-15-15-20-20-20-20-23, antennal ratio 0.79; anten-



Figs. 22–30. *Forcipomyia winderi*: 22–25, 29, 30, female; 26–28, male; 22, antenna; 23, palpus; 24, 26, wing; 25, striated scales of body and legs; 27, aedeagus; 28, genitalia, aedeagus omitted; 29, fore, mid, and hind legs (top to bottom); 30, spermathecae (scale in microns).

nal verticils short and strong. Palpus (Fig. 23) with lengths of segments in proportion of 8-12-17-9-8; third segment slightly swollen in midportion, spindle-shaped, with unusually small, shallow, round, sensory pit. Mandible without teeth.

Thorax: Reddish brown; mesonotum somewhat paler in midportion, clothed abundantly with long, pale brown, bristly, erect setae and fine, yellowish, appressed hairs. Scutellum paler in midportion. Legs (Fig. 29) yellowish, with brownish bands as

figured: fore and mid femora pale, tibiae with narrow basal and broad apical bands; hind femur with broad apical, and hind tibia with broad basal and narrow subapical bands; bands more intense on hind leg; femora and tibiae with some long, brownish, bristly setae, and abundantly clothed with broad, sharp-pointed, 4- or 5-striated scales (Fig. 25). Hind tibial spur short and pointed, nearly straight, about as long as breadth of tibia. Tarsomeres dark banded in midportion; hind tarsal ratio 1.07; claws slender

and curved. Wing (Fig. 24) dark brown, abundantly clothed with long, one-striated macrotrichia, these especially stout and dense over radial veins, this area appearing blackish; a moderately large pale anterior spot just past end of costa in cell R5, the macrotrichia pale yellowish in this area. Halter pale.

Abdomen: Pale yellowish brown proximally, becoming dark brown distally; clothed with sparse setae, and abundantly with appressed, flattened, striated, sharp-pointed scales (Fig. 25), latter varying in width, and with 2 to 5 striations. Two rather small ovoid spermathecae (Fig. 30) without distinct necks; slightly unequal, 0.072 by 0.046 mm and 0.061 by 0.043 mm.

Male allotype.—Wing length 1.30 mm, breadth 0.43 mm; costal ratio 0.42. Similar to the female with the usual sexual differences. Wing (Fig. 26) much narrower, uniformly pale yellowish, with fine macrotrichia except costal field provided with abundant, broad, scale-like macrotrichia forming a prominent dark area, another small, dark-scaled area on anterior margin at midlength of cell R5. Antenna with prominent plume of strong verticils, these brown on basal half of plume, yellowish on distal half; lengths of flagellar segments in proportion of 26-15-14-14-15-15-16-16-17-33-30-35, antennal ratio 1.00. Palpus slender; lengths of segments in proportion of 2-13-17-10-10; palpal ratio 2.4. Hind leg with lengths from femur to tarsomere 5 as 94-96-28-30-20-13-10; tarsal ratio 0.93; tibial spur longer than in female, 1.3 times as long as apical breadth of tibia. Abdomen yellowish; terga with posterolateral corners brownish forming broken segmental bands; distal segments provided with broad striated scales, increasing in breadth and number posteriorly, ninth tergum with dense broad scales.

Genitalia (Fig. 28): Ninth sternum slightly concaved caudad, brownish on posterolateral corners; basistyle moderately broad, brownish on distal half; dististyle slender

and nearly straight, entirely brownish. Aedeagus (Fig. 27) unusually long, more than twice as long as basal breadth; basal arms unusually short, sides slightly convex, tapering gradually to pointed tip which appears to be slightly cleft. Parameres forming nearly straight, slender rods reaching level of tip of aedeagus, their bases broadly separated on the strongly sclerotized, ribbon-like connective between the basistylar apodemes.

Immature stages.—Unknown.

Distribution.—Brazil, Ecuador.

Types.—Holotype female, Brazil, Bahia, Itajuípe, Fazenda Almirante, 4.v.1988, J. A. Winder; allotype male, same data but 23.v.1988 (in USNM). Paratypes, 76 males, 37 females, as follows: Brazil, Bahia, same data as types, but dates v.1987–x.1989, 50 males, 19 females; Bahia, Itabuna, 1970, J. A. Winder, reared from rotting cacao pods, 1 male, 1 female; same, but taken 1970–1971 in emergence traps, 20 males, 12 females. Ecuador, Quemado, Pichilingue, N.I.A.P., iv–v.1978, J. Mendoza, reared from rotting vegetation, 5 males, 5 females.

Discussion.—This species is named in honor of John A. Winder of Curitiba, Brazil in recognition of his outstanding research on the ceratopogonid pollinators of cocoa in Brazil.

Winder (1977a: 58) reported that this species (listed as a banded-legged species of *Forcipomyia* (*Forcipomyia*) comprised 3.8% of the total catch of ceratopogonid midges collected in cocoa flowers at CEPLAC in Bahia, Brazil. This species was also reared from rotting cocoa pods.

KEY TO NEOTROPICAL SPECIES OF THE
FORCIPOMYIA BICOLOR GROUP

- 1. Femora dark from base to tip (narrow knee spots may be pale, narrow bases may be pale) 2
- Femora extensively pale proximally, may be entirely pale 5
- 2. All tibiae entirely dark; antenna long, segments with narrow base swollen, abruptly narrowed to long, slender, distal portion;

- mesonotum with four pairs of lines of white scales *squamithorax* Clastrier
- At least hind tibia with broad sub-basal pale band; mesonotum and hind tibia various . . . 3
 - 3. Antenna short, segments short tapering; all tibiae with broad sub-basal to median pale bands (faint on fore leg); female wing without pale spot or pale areas; small species, wing length 1.1–1.5 mm . . . *abercrombyi* Macfie
 - Antenna long, segments with narrow bases swollen, abruptly narrowed to long slender distal portion; larger species, wing length 1.3–1.8 mm 4
 - 4. Basal dark brown band in hind tibia narrow, not as broad as second band; hind femur with narrow distal pale band at knee distinct *dubia* Macfie
 - The two dark brown bands on hind tibia about equal in width; hind femur with narrow distal pale band at knee indistinct . . . *lacrimotorii* Macfie
 - 5(1). Fore and mid femora entirely pale; female wing mottled with pale and dark areas; antenna short and stubby; third palpal segment with deep pit *seminole* Wirth
 - Fore and/or mid femora with brown bands; antenna long; female wing dark or mottled; palpal pit various 6
 - 6. Fore and mid femora pale except mid femur with basal dark band *flavifemoris* Macfie
 - Fore and mid femora dark on distal half or more 7
 - 7. Legs pale with narrow dark bands; female wing mottled; third palpal segment of female slender with shallow pit; spur of hind tibia slender, straight, pale; female genital sclerotization without spines or long setae; male basistyle and dististyle with pale bases . . . *winderi* new species
 - Legs with extensive, broad dark bands; female wing dark; third palpal segment of female swollen to past midportion with deep pit; spur of hind tibia long, curved, dark with pale base; female genital sclerotization with tuft of long setae on ends, with several short spines along midportion; male basistyle and dististyle various 8
 - 8. Both male fore claws slender throughout; male dististyle pale, basistyle pale at base; aedeagus with two lateral grooves; spermathecae large, oval, short neck present *bicolor* Lutz
 - One male fore claw with ventral tooth; male dististyle brown distally, often to base; basistyle variably brownish to base; aedeagus with two lateral and one median, longitu-

dinal grooves; spermathecae small, slightly ovoid, no neck *discoloripes* Macfie

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